(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 203 890 A1

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 158(3) EPC

(43) Date of publication:
08.05.2002 Bulletin 2002/19

(21) Application number: **00937245.9**

(22) Date of filing: **15.06.2000**

(51) Int Cl.[7]: **F16C 11/10**, E05D 11/08

(86) International application number:
PCT/JP00/03903

(87) International publication number:
WO 00/77413 (21.12.2000 Gazette 2000/51)

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **15.06.1999 JP 16857599**

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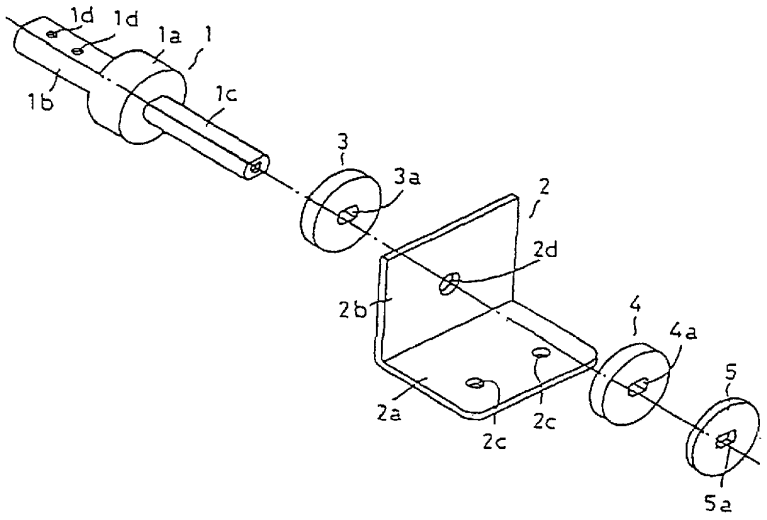
(54) **SHAFT LOCK DEVICE**

(57) A shaft lock apparatus, the tilt angle between the shaft and the rotated member of which is adjusted with a stable friction torque as well as the structure of which is simple. It is furnished with the rotated member 2 through which the shaft 1 pierces in a condition of free rotation, and with elastic pressure members 3, 4 through which the shaft 1 pierces in a condition of bound rotation to keep the relative angle between the rotated member 2 and the shaft 1 at any intended angle by pressurizing the rotated member 2.

Fig. 1



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Description

Field of the invention

[0001] The present invention relates to a shaft lock apparatus that is included in a member, such as a display device of a notebook personal computer, a notebook word processor, a mobile terminal apparatus, or an LCD monitor, or a rotatable lid of various machines, or the like, whose tilt angle is necessary to be adjusted.

Background of the invention

[0002] Figure 28 illustrates a conventional shaft lock apparatus stated in Japanese Utility Model Publication No. 2547422. This shaft lock apparatus is composed of a slider washer 110, a rotated member 120, a friction washer 130, a spring washer 140 and a retaining washer 150, which are coaxially installed to a shaft 100. Moreover, in the rotated member 120, a fitting plate portion 123, which is fixed on the main body of the device supporting a display panel or the like to be capable of rotating is formed.

[0003] The shaft 100 is furnished with a flange portion 101, a fitting axis portion 102 which extends from one side of the flange portion 101 and is non-circular shaped, and a connecting axis portion 103 which extends from the other side of the flange portion 101 is circular shaped. This shaft 100, of which fitting axis portion 102 is fitted with a mating member, such as a display panel, rotates with rotation of the mating member in one united body.

[0004] On the other hand, the connecting axis portion 103 pierces through the slider washer 110, the rotated member 120, the friction washer 130, the spring washer 140, and the retaining washer 150 and in each of the slider washer 110, the rotated member 120, the friction washer 130, the spring washer 140, and the retaining washer 150 axial holes 111. 121. 131, 141, and 151 are formed to be pierced by the connecting axis portion. By caulking a piercing end portion of the connecting axis portion 103 which pierces through these members, the slider washer 110, the rotated member 120, the friction washer 130. the spring washer 140 and the retaining washer 150 are put together in piles, being pressurized by the spring washer 140. Because this pressure causes a friction torque, the shaft 100 and the rotated member 120 are held at any intended relative angle, thereby the tilt angle of the display panel can be adjusted.

[0005] In such a conventional shaft lock apparatus, it is not specifiable which member rotates because any member can rotate against the shaft 100 at the time of the relative rotation of the shaft 100 and the 120. Consequently, the region where a friction arises cannot be specified and the friction torque varies in different rotating members. This makes it impossible to secure a stable friction torque. Also, the number of the members which cause a friction torque is large and the apparatus is hard to assemble because of the complicated structure thereof.

[0006] The object of the present invention, based on the consideration of such problems of the conventional apparatus, is to provide a shaft lock apparatus which is capable of causing a stable friction torque and, furthermore, is capable to keep any intended tilt angle with the simple structure.

Summary of the Invention

[0007] For the abovementioned object, the invention set forth in Claim 1 is characterized in that it is furnished with a rotated member, through which the shaft pierces in a condition of free rotation, and an elastic pressure member, through which the aforementioned shaft pierces and which keeps the relative angle between the rotated member and the shaft at any intended angle by pressurizing the rotated member.

[0008] In this invention, because the rotation of the elastic pressure member is bound against the shaft, the elastic pressure member rotates in one united body with the shaft when the relative rotation of the shaft and the rotated member takes place. In this rotation the relative angle between the rotated member and the shaft can be kept at any intended angle because the friction torque arises by the elastic pressure member pressurizing the rotated member. In such a structure, it is possible to stabilize the friction torque because the elastic pressure member always rotates together with the shaft, and also easy assembly is enabled because of the simple structure as the number of the parts is small.

[0009] The invention set forth in Claim 2 is characterized that it is it is furnished with a rotated member, through which the shaft pierces in a condition of free rotation, and an elastic pressure member, through which the aforementioned shaft pierces in a condition of bound rotation and which keeps the relative angle between the rotated member and the shaft at any intended angle by pressurizing the rotated member, and a friction plate, through which the aforementioned shaft pierces, to be superposed on the aforementioned rotated member.

[0010] This invention includes either structure of the case where the friction plate is placed between the shaft and the rotated member and the elastic pressure member is placed to put the rotated member between the elastic member and the friction plate, or the case where the elastic pressure member is placed between the shaft and the rotated member and the friction plate is placed to put the rotated member between the friction plate and the elastic pressure member.

[0011] In the invention set forth in Claim 2 the elastic pressure member and the friction plate rotate together with the shaft in one united body in the relative rotation of the shaft and the rotated member. Consequently, a friction torque arises between the elastic member and the rotated member while a friction torque arises between the friction plate and the rotated member. Accord-

ingly, it is possible to stabilize the fiction torque because the extensive friction torque arises. Also, a simple structure is enabled because of the small number of the parts. Also, the durability improves because the friction plate is furnished.

[0012] The invention set forth in Claim 3 is characterized that it is furnished with a friction plate, through which the shaft pierces in a condition of bound rotation, and a rotated member through which the shaft pierces in a condition of free rotation, and an elastic pressure member through which the shaft pierces in a condition of bound rotation, and a retaining plate through which the shaft pierces in a condition of bound rotation, all of which are fit together in piles on the shaft in such consecutive order, and that the relative angle between the rotated member and the shaft is kept at any intended angle by the elastic pressure member pressurizing the rotated member by caulking the piercing end of the shaft which pierces through the retaining plate.

[0013] In this invention the friction plate, the rotated member, the elastic pressure member and the retaining member are in the superposed condition by caulking the piercing end of the shaft, after the friction plate, the rotated member, the elastic pressure member and the retaining member are fit on the shaft in the said consecutive order. Under this condition, because the friction plate and the elastic pressure member rotate together with the shaft, a friction torque arises between the elastic pressure member and the rotated member while a friction torque arises between the friction plate and the rotated member. Accordingly, the friction torque is stabilized and the relative angle between the rotated member and the shaft can be kept with surety.

[0014] The invention set forth in Claim 4 is any invention stated in the Claims 1 to 3 which is characterized in that the aforementioned elastic pressure member has a shape having a flat portion and a rising portion which rises from the both sides of the flat portion.

[0015] In this invention a friction torque arises by the flat portion being deformed and the border portion between the flat portion and the rising portion being linearly contacted with the pressurizing force on the rising portion. Accordingly, the relative angle between the rotated member and the shaft can be kept with surety.

[0016] The invention set forth in Claim 5 is any invention stated in the Claims 1 to 3 which is characterized in that the aforementioned elastic pressure member is curved in a C-shape.

[0017] In this invention the elastic pressure member is made flat by a pressurizing force and facially contacts with the rotated member to bring forth a friction torque. Accordingly, the relative angle between the rotated member and the shaft can be kept with surety.

[0018] The invention set forth in Claim 6 is any invention stated in the Claims 2, 4 or 5 which is characterized in that at least a friction plate placed between the aforementioned rotated member and the elastic pressure member is incorporated in the rotated member in one united body.

[0019] In this invention, because the friction plate is placed between the rotated member and the elastic pressure member, under the condition that the friction member is in one united body with the rotated member, the elastic pressure member does not directly contact with the rotated member so that it is possible to prevent the rotated member from being abraded. Therefore, as a large intensity is not necessary as a rotated member, it is possible to utilize cheap materials while a more extensive scope of materials can be chosen.

[0020] The invention set forth in Claim 7 is any invention stated in the Claims 1 to 6 which is characterized in that at least two of the aforementioned elastic pressure members are placed along the aforementioned shaft.

[0021] In this invention, by superposing a plurality of the elastic pressure members on the both sides, it is possible to increase flexure volume in all of the elastic pressure members and is possible to adjust a friction torque extensively. Also, it is possible to obtain a large friction torque because of a pressurizing force increased by superposing a plurality of the elastic pressure members in the same direction.

[0022] The invention set forth in Claim 8 is any invention stated in the Claims 1 to 7 which is characterized in that at least two of the aforementioned elastic pressure members are placed to sandwich the aforementioned rotated member from the both sides.

[0023] In this invention, because of the sandwiching the rotated member from the both sides by a plurality of the elastic pressure member, it is possible to increase flexure volume in all of the elastic pressure members. Thereby, it is possible to adjust a friction torque extensively in all of the elastic pressure members.

[0024] The invention set forth in Claim 9 is any invention stated in the Claims 4 or 5 which is characterized in that a lubricant retainer portion which retains lubricant is formed in the aforementioned elastic pressure member.

[0025] In this invention the durability improves because the lubricant from the lubricant retainer portion lubricates.

Brief description of the drawings

[0026]

Figure 1 is an exploded view of the embodiment 1 of the present invention.

Figure 2 is a front view of the embodiment 1 under an assembled condition.

Figure 3 is an exploded view of the embodiment 2.

Figure 4 is a front view of the embodiment 2 under an assembled condition.

Figure 5 is an exploded view of the embodiment 3.

Figure 6 is a front view of the embodiment 3 under an assembled condition.

Figure 7 is an exploded view of the embodiment 4.

Figure 8 is an exploded view of the embodiment 5.
Figure 9 is an exploded view showing a variation of the embodiment 5.
Figure 10 is an exploded view of the embodiment 6.
Figure 11 is an exploded view of the embodiment 7.
Figure 12 is an exploded view of the embodiment 8.
Figure 13 is a front view of the embodiment 8 under an assembled condition.
Figure 14 illustrates a U-shaped spring in the embodiment 9, and a front view of which is shown in (a) and a side view of which is shown in (b).
Figure 15 is a side view of the U-shaped spring illustrated in Figure 14, under a pressurized condition.
Figure 16 is a side view of a variation of the U-shaped spring.
Figure 17 illustrates another variation of the U-shaped spring, and a front view of which is shown in (a), a side view of which is shown in (b), a rear view of which is shown in (c), a partially enlarged sectional view of which is shown in (d).
Figure 18 illustrates a C-shaped spring, and a front view of which is shown in (a) and a side view of which is shown in (b).
Figure 19 is a side view of the C-shaped spring illustrated in Figure 18, under the pressurized condition.
Figure 20 illustrates another variation of the C-shaped spring, and a front view of which is shown in (a), a side view of which is shown in (b).
Figure 21 is a plan view of an angle adjusting device.
Figure 22 is a front view of an angle adjusting device.
Figure 23 is a bottom plan view of an angle adjusting device.
Figure 24 is a left side view of an angle adjusting device.
Figure 25 is a right side view of an angle adjusting device.
Figure 26 is a sectional view of a tilt shaft used in a shaft lock apparatus of an angle adjusting device.
Figure 27 is a plan view of a friction plate of an angle adjusting device.
Figure 28 is an exploded view of a conventional shaft lock apparatus.

Description of the preferred embodiments

[0027] The present invention will now be described in details according to the illustrated embodiments. In each embodiment the same symbols are put to the corresponding elements for reference.

(Embodiment 1)

[0028] Figures 1 and 2 shows the embodiment 1 of the present invention. A shaft lock apparatus of this embodiment is furnished with a shaft 1. a bracket 2 as a rotated member, elastic plates 3, 4 as an elastic pressure member and a retaining plate 5.

[0029] The shaft 1 has a thick flange portion 1a while a fitting axis portion 1b and a connecting axis portion 1c extend coaxially from this flange portion 1a. The fitting axis portion 1b is to be installed to a display panel (no drawings shown) and the like as a mating member and fixing holes 1d are formed for the fitting. The connecting axis portion 1c is to be fit with the bracket 2, the elastic plates 3, 4, and retaining plate 5. These connecting axis portion 1c and fitting axis portion 1b are shaped in a non-circular shape by parallel cutting.

[0030] The bracket 2 is bent in an L-shape where a shaft receiving plate portion 2b erects from a fixing plate portion 2a which is to be connected with a supporting member (drawings not shown) such as a main body to be furnished with a display panel. For this connection, in the fixing plate 2a, fixing holes 2c are formed. On the other hand, in the shaft receiving plate portion 2b, an axial hole 2d is formed and a connecting axis portion 1c of the shaft 1 pierces through this axial hole. Through the axial hole 2d, formed into a circular shape, the shaft 1 pierces so as to be rotatable, whereby the shaft 1 and the bracket 2 are capable of relative rotation.

[0031] The elastic plates 3, 4 as elastic pressure members are formed into a circular disk shape which has a similar diameter to the flange portion 1a of the shaft 1, and are placed on the both sides of the shaft receiving plate portion 2b of the bracket 2. In each of the elastic plates 3, 4, the axial holes 3a, 4a, which are in a non-circular shape as the shape of the connecting axis portion 1c of the shaft 1, are formed. The connecting axis portion pierces therethrough in an engaged condition. Consequently, the elastic plates 3, 4, of which rotation is bound with the shaft 1, rotates in one united body with the shaft 1.

[0032] Also, under the condition that the connecting axis portion 1c pierces through and the end portion of the connecting axis portion is caulked, the elastic plates 3, 4 are put on the both sides of the shaft receiving plate portion 2b to sandwich the shaft receiving plate portion. Such elastic plates 3, 4 directly contact with the both faces of the shaft receiving plate portion to elastically pressurize the bracket 2 and a friction torque between the elastic plate 3, 4 and the shaft receiving plate portion of 2b of the bracket 2 caused by such direct pressure makes it possible to keep the relative angle between the bracket 2 and the shaft 1 at any intended angle. In order to apply such elastic pressure, in this embodiment, such resin as thick rubber or elastomer is used for the elastic plates 3, 4. Furthermore, it is also possible to apply indirect pressure on the bracket 2 by inserting a spacer or an friction plate, which is mentioned later, between the elastic plates 3, 4 and the bracket 2.

[0033] The retaining plate 5 is made of a flat washer having a similar diameter to the elastic plates 3, 4 and an axial hole 5a is formed in its center. The axial hole

5a which is shaped into a non-circular shape as is the connecting axis portion 1c of the shaft 1, is pierced through by the connecting axis portion in an engaged condition. Consequently, the retaining plate 5 rotates together with the shaft 1 in one united body.

[0034] This shaft lock apparatus is assembled by piercing the connecting axis portion 1c of the shaft 1 through the axial hole 3a of the elastic plate 3, the axial hole 2d of the bracket 2 and the axial hole 4a of the elastic plate 4, while piercing the connecting axis portion 1c of the shaft 1 through the axial hole 5a of the retaining plate 5, and then caulking the piercing end portion of the connecting axis portion 1c. The symbol 6 in Figure 2 shows the caulking portion doing such caulking.

[0035] By such caulking, as shown in Figure 2, the flange portion 1a of the shaft 1 contacts with the elastic plate 3 and the retaining plate contacts with the elastic plate 4, whereby the elastic plates 3, 4 are put on the both sides of the shaft receiving plate portion 2b of the bracket 2 while they elastically pressurize the shaft receiving plate portion from the both sides. Thereby, a friction torque arises between the elastic plates 3, 4 and the bracket 2. Consequently, after a relative rotation of the shaft 1 and the bracket 2, it is possible to keep the relative angle between the shaft 1 and the bracket 2 at any intended angle.

[0036] In such embodiment, it is possible to stabilize the friction torque because the rotation of the elastic plate 3, 4 is bound and the elastic plates 3, 4 always rotates in one united body with the shaft 1 in the relative rotation of the shaft 1 and the bracket 2. Also, it enables easy assembly because of the simple structure as the number of the parts is small. Moreover, in this embodiment the two elastic plates 3, 4 sandwich the bracket 2 from the both sides, whereby it is possible to increase the whole flexure volume including that of the two elastic plates 3, 4. Therefore, it enables an extensive adjustment of the friction torque as a whole elastic plates so as to extend a variety of applicable apparatus.

(Embodiment 2)

[0037] Figures 3 and 4 show a shaft lock apparatus of the embodiment 2. In this embodiment, metal wave springs 7, 8 are used for an elastic pressure member. The wave springs 7, 8 are placed on the both sides of the shaft receiving plate portion 2b of the bracket 2 while in both of them axial holes 7a, 7b, which are similar to the outer shape of a connecting axis portion 1c of a shaft 1, are formed and the connecting axis portion 1c pierces through them in an condition of engagement. Accordingly, the elastic pressure members 7, 8, of which rotation is bound on the shaft 1, rotates together with the shaft 1 in one united body.

[0038] Also in such a structure, the pressure of the wave springs 7, 8 works directly on the bracket 2 by caulking an end portion of the connecting axis portion 1c of the shaft 1, whereby a friction torque arises so as to enable the angle between the shaft 1 and the bracket 2 to be kept at any intended angle. Also, because the wave springs 7, 8 always rotate together with the shaft 1 in one united body, a simple structure with a small number of parts is possible as well as the friction torque is stabilized. Furthermore, because the wave springs 7, 8 are placed on the both sides of the bracket 2, it is possible to increase a whole flexure volume including that of the wave springs 7, 8 so as to make an extensive adjustment of a friction torque. Also in this embodiment, it is possible to insert a spacer, a friction plate or the like between the wave springs 7, 8 and the bracket 2 so as to apply pressure indirectly.

(Embodiment 3)

[0039] Figures 5 and 6 shows an embodiment 3 of the present invention. In this shaft lock apparatus, a friction plate 9, which, in this embodiment, is placed on the side of the shaft 1, is used.

[0040] The friction plate 9 is in a disk shape, of which diameter is similar to that of a flange portion 1a of the shaft 1, and in its center an axial hole 9a, of which shape is the same as the outer shape of a connecting axis portion 1c of the shaft 1, is formed. The friction plate 9, made of metal, such as stainless, is sandwiched between the flange portion 1a of the shaft 1 and the shaft receiving portion 2b of the bracket 2, whereby it is put on a shaft receiving portion 2b.

[0041] Also, through an axis portion 9a of the friction plate 9, a connecting axis portion 1c of the shaft 1 pierces in a condition of engagement. Accordingly, the friction plate 9, which is under the condition that its rotation is bound on the shaft 1, rotates together with the shaft 1 in one united body in a condition that it is put on the bracket 2 in piles. In this rotation the friction plate 9 brings forth a friction torque on a face contacting with the bracket 2.

[0042] In such a structure, the friction plate 9 is substituted for one elastic plate 3 of the two elastic plates 3, 4 of the embodiment 1. The friction plate 9 always rotates together with the shaft 1 in one united body so as to bring forth a friction torque between the bracket 2 and itself. Also, the elastic plate 4 rotates together with the shaft 1 in one united body so as to bring forth a friction torque between the bracket 2 and itself. Thereby, friction torque arises between the friction plate 9 and the elastic plate 4 and the shaft receiving plate portion 2b of the bracket 2, whereby it is possible to bring forth a stable friction torque. Also, a simple structure with a small number of the parts is possible.

[0043] In the friction plate 9 of this embodiment, a plural of lubricant retaining portions 9b are formed. The lubricant retaining portions 9b are composed of lubricant retaining holes 9b which pierce through the friction plate 9 in the thickness direction. The lubricant retaining holes are to be replenished with lubricants, such as grease and are formed around the axial hole 9a so as to supply

the lubricant retained inside to the face bringing forth a friction torque (the face contacting with the bracket 2). Thereby, it is possible to improve durability because of the lubrication. It should be noted that grooves or indentations, if not piercing holes, can be also used for the lubricant retaining portion 9b. Also, in this embodiment, the friction plate can also be made of resin and if it is so made of resin the lubricant retaining holes are not necessary. In addition, in this embodiment, the same effect can be obtained if the friction plate 9 is placed in the side of the retaining plate 5 and the elastic plate 4 is placed in the side of the shaft 1. Also, a friction plate 9 or a spacer can be inserted between the elastic plate 4 and the bracket 2.

(Embodiment 4)

[0044] Figure 7 shows a shaft lock apparatus of the embodiment 4. In a shaft lock apparatus of this embodiment, a wave spring 8, instead of the elastic plate 4 of the embodiment 3, is used for the elastic pressure member and the others are the same as in the embodiment 3. Accordingly, also in this embodiment, a friction plate 9 always rotates together with the shaft 1 in one united body, in addition to the rotation of the wave spring 8, whereby it is possible to bring forth a stable friction torque, and, in addition, to enable a simple structure with a small number of the parts. It should also be noted that a friction plate 9 or the like can be inserted between the wave spring 8 and the bracket 2.

(Embodiment 5)

[0045] Figure 8 shows an embodiment 5 of the present invention, which are furnished with a friction plate 9, a bracket 2, a U-shaped spring 21 as an elastic pressure member, and a retaining plate 5. In a shaft 1, a fitting axis portion 1b and a connecting axis portion 1c extend coaxially from the both sides of a flange portion 1a. The connecting axis portion 1c is shaped in a non circular shape by parallel cutting. To the end portion of the fitting axis portion 1b, a fitting tip 1e, which is shaped like a thin plate, is adjacently formed and a fixing hole 1d is drilled out in this fitting tip 1e.

[0046] The friction plate 9 is shaped in a disk shape of which diameter is equal to that of the flange portion land in its center a axial hole 9a, which is in the same shape as the outer shape of the connecting axis portion 1c, is drilled out. Around the axial hole 9a, a plural of lubricant retaining holes are drilled out as a lubricant retaining portion. In such lubricant retaining holes, lubricant such as grease is filled and retained. Also, the bracket 2 has a circular-shaped axial hole 2d through which the connecting axis portion 1c pierces in a condition of free rotation.

[0047] The U-shaped spring 21 has a shape having a flat portion 21b, and rising portions 21c which erect from the both sides of the flat portion 21b. In the flat portion 21b, an axial hole 21a, through which the connecting axis portion 1c of the shaft 1 pierces in a condition of engagement, is formed. In other words, the axial hole 21a is a hole of a similar shape to the outer shape of the connecting axis portion 1c. The U-shaped spring 21 is placed so that the bottom face of the flat portion 21b meets the shaft receiving plate portion 2b of the bracket 2.

[0048] The retaining plate 5 has an axial hole 5a through which the connecting axis portion 1c of the shaft 1 pierces in a condition of engagement. This retaining plate 5 is set from the outside of the U-shaped spring 21.

[0049] To assemble an apparatus of this embodiment, the connecting axis portion 1c is pierced through the abovementioned members in the order of the friction plate 9, bracket 2, U-shaped spring 21 and then the retaining plate 5 to superpose them. Then, by caulking the piercing end of the connecting axis portion 1c which pierces through the retaining plate 5, a caulking portion 6 as shown in Figure 2 is formed. With so caulking the U-shaped spring 21 is pressurized by the retaining plate toward the shaft receiving plate portion 2b of the bracket 2, whereby a friction torque is brought forth between the shaft receiving plate portion 2b and the U-shaped spring. Also, a friction torque arises between the friction plate 9 and the shaft receiving plate portion 2b of the bracket 2. Thereby, the relative angle between the shaft 1 and the bracket 2 can be kept at any intended angle. Also, because the lubricant from the lubricant retaining holes 9b of the friction plate 9 is supplied to the face bringing forth the friction torque to lubricate, durability can improve. As for the function of the U-shaped spring, it will be described in details in the undermentioned embodiment 9.

[0050] Figure 9 shows a variation of the embodiment 5. In this embodiment, a U-shaped spring 21 is placed between a shaft 1 and a bracket 2 and a friction 9 is placed the bracket 2 and a retaining plate 5. Also in this variation a friction torque is brought forth between the U-shaped spring 21 and the shaft receiving plate portion 2b of the bracket 2 and between the friction plate 9 and the shaft receiving plate portion 2b by piercing the connecting axis portion 1c of the shaft 1 through the retaining plate 5 and then caulking its piercing end, whereby the relative angle between the shaft 1 and the bracket 2 can be kept at any intended angle. It should also be noted that in Figures 8 and 9, by inserting a friction plate 9 or a spacer between the U-shaped spring 21 and the bracket 2, a structure of which U-shaped spring 21 indirectly pressurizes the bracket 2 is also possible.

(Embodiment 6)

[0051] Figure 10 shows an embodiment 6. In this embodiment, in contrast with the abovementioned embodiment 5, two U-shaped springs are used for elastic members. The two U-shaped springs 21 are placed between a bracket 2 and a retaining plate 5 to superpose. In this

case, the U-shaped spring 21 which is located in the side of the bracket 2 is so placed that the bottom face of its flat portion 21b contacts with the shaft receiving plate portion 2b of the bracket 2. In this embodiment, the rising portion 21c of one U-shaped spring 21 and the rising portion 21c of the other U-shaped spring 21 are superposed so as to contact with each other (in other words, so that the two U-shaped springs 21 are crossed). Then, by caulking the piercing end of the connecting axis portion 1c which pierces through the retaining plate 5, the shaft receiving plate portion 1b of the bracket 2 is pressurized in the condition that the U-shaped springs 21, 21 are superposed.

[0052] In such an embodiment, the two U-shaped springs 21, 21 are placed along the shaft so that the flexure volume of a plurality of the U-shaped springs can be increased as a whole. Thereby an extensive adjustment of the friction torque is possible. Also, in this embodiment, it is possible to superpose the U-shaped springs 21 in the same direction and, by so superposing, a large friction torque can be obtained because of an increase of pressure of the U-shaped springs as a whole.

[0053] In such a structure mentioned above, even if the spring constant of the U-shaped springs is small as the diameter of the U-shaped spring is small or the thickness thereof is small, it is possible to bring forth an intended friction torque because a plurality of the U-shaped springs are used. It should also be noted that the number of the U-shaped springs 21, as elastic pressure members, can be adjustably changed according to the designed torque as a shaft lock apparatus. Also, a friction plate or a spacer can be inserted between the U-shaped springs 21 and the bracket 2.

(Embodiment 7)

[0054] Figure 11 shows an embodiment 7. In this embodiment the friction plate 9 used in the embodiment 5 is omitted. In other words, a connecting axis portion 1c of the shaft pierces through a bracket 2, a U-shaped spring 21 and a retaining plate 5 and, by caulking the piercing end thereof, a flange portion 1a of the shaft 1, a shaft receiving plate portion 2b of the bracket 2, the U-shaped spring 21 and a retaining plate 5 are superposed and the relative angle between the shaft 1 and the bracket 2 is kept by a friction torque brought forth by a direct pressure of the U-shaped spring 21. In this embodiment friction arises between the flange portion 1a of the shaft 1 and the shaft receiving plate portion 2b of the bracket 2 and a long use is possible if such friction is small or if these members are made of an abrasion-proof material. In such embodiment there are such merits as light weight as well as simple assembly because of a small number of the parts. Also in this embodiment, it is possible to apply an indirect pressure by inserting a friction plate or a spacer between the U-shaped spring 21 and the bracket 2 and between the flange portion 1a of the shaft 1 and the shaft receiving plate portion 2b of the bracket 2.

(Embodiment 8)

[0055] Figures 12 and 13 shows a shaft lock apparatus of the embodiment 8. In this shaft lock apparatus three friction plates are used and, that is to say, a first friction plate 61, a second friction plate 62 and a third friction plate 63 are placed. These friction plates 61, 62 and 63 are formed in a shape of a circular plate of similar diameters. The first friction plate 61 and the second friction plate 62 are set between the shaft 1 and the bracket 2. In this case, the first friction plate is placed in the side of the shaft 1 and the second friction plate is placed in the side of the bracket 2. On the other hand, the third friction plate 63 is placed to sandwich the bracket 2 between these friction plates 61, 62 and itself.

[0056] In the second friction plate, engaging prominence portions 64, 64 are formed at an interval of 180 degree on the face facing the bracket 2. Also, in the third friction plate, sandwiching the bracket 2 between the second friction plate 62 and itself, on the face facing the bracket 2, engaging prominence portions 65, 65 are formed at an interval of 180 degree, but are formed to be located to cross the engaging prominence portions 64, 64 of the second friction plate at right angle.

[0057] To be correspondent with that, around an axial hole 2d in a shaft receiving plate portion 2b of the bracket 2, engaging hole portions 67 are formed at an interval of 90 degree. Each of these engaging hole portions 67 is to be engaged by the engaging prominence portions 64, 64 and the engaging prominence portions 65, 65 and, by such engagement, these friction plates 62, 63 are to be fixed on the bracket 2.

[0058] Also, in the second friction plate 62 and the third friction plate 63, lubricant retaining portions which are made of a hole drilled out are furnished. The lubricant retaining portions are furnished to be located between the engaging prominence portions 64, 65 in each of the friction plates 62, 63. It should also. be noted that in the center of the second friction plate 62 and that of the third friction plate 63, circular shaped axial holes 62a, 63a, through which the connecting axis portion 1c of the shaft 1 pierces in a rotatable condition, are formed.

[0059] The first friction plate 61 located in the side of the shaft 1 is a flat face where no engaging prominence portions or lubricant retaining portions which are described above are formed. In this first friction plate 61, one flat face contacts with an end face 1f of the shaft 1 while the other flat face contacts with the second friction plate 62. By so contacting, it covers the lubricant retaining portions 69 which are formed in the second friction plate 62.

[0060] Through the center of the first friction plate 61 the axial hole 61a are drilled out, but this axial hole 61a is shaped in a non circular shape as is the outer shape

of the connecting axis portion 1c of the shaft 1. Accordingly, through the axial hole 61a the connecting axis portion 1c pierces in a condition of engagement, whereby the first friction plate 61, of which rotation is bound on the shaft 1, rotates together with the shaft 1 in one united body.

[0061] In this embodiment, a wave spring 8, as an elastic pressure member, is placed between the third friction plate 63 and the retaining plate 5. In the wave spring 8, the axial hole 8a is shaped in a non circular shape as is the connecting axis portion 1c of the shaft 1 and is to be pierced through by the connecting axis portion 1c, whereby the rotation is bound by the connecting axis portion 1c and is together with the shaft 1 in one united body. It should also be noted that the axial hole 5a of the retaining plate 5 has a non circular shape and, by an engagement of the connecting axis portion 1c of the shaft, rotates together with the shaft 1 in one united body.

[0062] Figure 13 shows a condition that a shaft lock apparatus of this embodiment is assembled, where the connecting axis portion 1c pierces through the first friction plate 61, the second friction plate 62, the bracket 2, the third friction plate 63, the wave spring 8 and the retaining plate 5 in such order and a pressure is to be brought forth in the wave spring 8 by caulking this piercing end portion. In Figure 13, the symbol 6 denotes the caulking portion, which is formed by caulking the piercing end portion of the shaft 1.

[0063] In the assembled condition of this embodiment, the first and the second friction plates 62, 63 are in one united body with the bracket 2 while the first friction plate 61, the wave spring 8 and the retaining plate 5 are in one united body with the shaft 1. In this assembled condition, in a relative rotation of the shaft 1 and the bracket 2, a friction torque arises on the contacting face between the first friction plate 61 and the second friction plate 62 and on the contacting face between the third friction face 63 and the wave spring 8. Therefore, the relative angle between the shaft 1 and the bracket 2 can be kept at any intended angle.

[0064] In this embodiment, the third friction plate 63 is placed between the bracket 2 and the wave spring 8 in a condition that it is in one united body with the bracket 2, whereby the wave spring 8 does not directly contact with the bracket 2 and, therefore, abrasion of the bracket 2 can be prevented. Consequently, a large intensity is not necessary for the bracket 2 and the bracket 2 can be made of cheap materials. For example, in the case that the friction plates 61, 62, 63 are made of stainless steel or phosphor bronze, SPCC can be used for the bracket 2, which enables a cheaper price. Furthermore, it enables more extensive choices of the materials for the bracket 2.

[0065] Also, in this embodiment, because the first friction plate 61 and the second friction plate 62 are flat, these friction plates 61, 62 are capable of contacting with each other in a condition of close adhesion. Accordingly, the first friction plate 61 can with sure cover the lubricant retaining portion 69 furnished in the second friction plate 62 so that the lubricant does not leak out of the lubricant retaining portion 69. Therefore, lubrication with the lubricant can be done with surety. By this lubrication, abrasion of the friction plates 61 and 62 can be controlled. Also, alien substances do not get into the region between the first friction plate 61 and the second friction plate 62, where a friction torque arises, whereby it is possible to adjust the tilt angle without troubled rotation.

[0066] It should also be noted that in this embodiment it is possible to place a friction plate only in the side of the wave spring 8 and to omit the friction plates 61, 62 which are placed between the bracket 2 and the shaft 1. Also, it is possible to form engaging hole portions in the second and the third friction plates 62, 63 and to form engaging prominence portion in the bracket 2 to fix the friction plate 62, 62 on the bracket 2, and other fixing structures are also possible.

(Embodiment 9)

[0067] In this embodiment, various elastic pressure members which can be used for a shaft lock apparatus of the present invention will be described.

[0068] Figures 14 and 15 show a U-shaped spring as an elastic pressure member. The U-shaped spring 21 has a circular shape and is furnished with a flat contact face portion 21b, which has a similar diameter to that of the axial hole 21and rising portions 21c, which erect outwardly from the both sides of the flat portion 21b. The rising portions 21c slantingly erect in the same direction from the both sides of the flat portion 21b. The U-shaped 21 is so placed that the bottom face 21f of the flat portion 21b meets with the shaft receiving plate portion 2b of the bracket 2.

[0069] Figure 15 shows a condition that the U-shaped spring 21 is pressurized by assembling the shaft lock apparatus. Pressurizing force P works on the rising portion 21c and, by this pressure, the flat portion 21b invertingly rises in a curved shape. Consequently, the border region 21e of the flat portion 21b and of the rising portion 21c linearly contacts with the shaft receiving plate portion 2b of the bracket 2. Because a friction torque is brought forth, by this linear contact, between the bracket 2 and the spring, the relative angle between the shaft 1 and the bracket 2 can be kept.

[0070] In this case, an opening 21g is formed between the flat portion 21, which is rising, and the shaft receiving plate portion 2b of the bracket 2. Accordingly, by daubing a lubricant such as grease on the bottom face of the U-shaped spring, the lubricant can be retained in the opening 21g. Thereby, it is possible to improve durability.

[0071] Figure 16 shows a variation of the U-shaped spring 21. In this variation of the U-shaped spring 21, in contrast with the rising portions 21c, the flat portion 21b

is thicker, wherefore the flat portion 21b is given the more rigidity. In such structure, the flat portion 21b, which is of a large rigidity, does not deform to be curved if the rising portions are pressurized. Consequently, a friction torque arises in a condition. that the bottom face 21h of the flat portion 21b facially contacts with the bracket 2.

[0072] The U-shaped spring 21 shown in Figure 17 is furnished with a lubricant retaining portion 21d in contrast with the U-shaped spring 21 shown in Figure 14. The lubricant retaining portion 21d is so formed that it is a groove of which sections are a polygon such as a triangle. Also, the lubricant retaining portion 21d is placed in the side of the flat portion 21b meeting with the bracket 2 so as to be lubricated by the lubricant between the bracket 2 and itself. Accordingly, it has a merit of improvement of durability by lubrication of the lubricant.

[0073] The elastic pressure member shown in Figures 18 and 19 is C-shaped spring 20. In the center of the C-shaped spring 20 an axial hole 20a, through which the connecting axis portion 1c pierces in a condition of engagement, is drilled out. Also, the C-shaped spring 20 is shaped like a letter C, which is curved in one direction with a gentle curvature. Consequently, the C-shaped spring 20 is so shaped that the rising portions 20c, which erect like a curve in the both sides of the central portion 20b, are formed in one united body.

[0074] Figure 19 shows a condition that the C-shaped spring 20 is pressurized when a shaft lock apparatus is assembled. Before applying a pressurizing force P, the condition is such as is shown by the chain line, but when a pressurizing force P is applied on the rising portions 20c, the rising portion 20c approaches the shaft receiving plate portion 2b of the bracket 2. Thereby, the central portion 20b facially contacts with the shaft receiving portion 2b of the bracket 2. Because a friction torque is brought forth between the bracket 2 and the spring by this facial contact, the relative angle between the shaft 1 and the bracket 2 can be kept.

[0075] In C-shaped spring 20 shown in Figure 20, in contrast with the C-shaped spring shown in Figure 16, lubricant retaining portions 20d are formed. The lubricant retaining portions 20d are made of elliptic drilled holes which are drilled out to be opposite to each other across the axial hole 20a. This lubricant retaining portions 20d are formed to be located in the central portion 20b. Thus the lubricant retaining portions 20d are furnished in the C-shaped spring 20, whereby the durability can be so improved that the lubrication of the lubricant functions effectively.

[0076] The U-shaped springs 21 and the C-shaped springs 20 can be applied as they are to the embodiment 2, shown in Figures 3 and 4, the embodiment 4, shown in Figure 7, the embodiment 5, shown in Figures 8 and 9, the embodiment 6, shown in Figure 10, the embodiment 7, shown in Figure 11, and the embodiment 8, shown in Figures 12, 13.

(Embodiment 10)

[0077] Figures 21 to 27 show an embodiment of the angle adjustment device to which the abovementioned embodiments are applied. The angle adjustment device is furnished with a base 30, a base bracket 31, two tilt brackets 32, 33. The base 30 is to be fixed on a supporting stand (drawings not shown). The base bracket 31 is fitted on this base 30 so as to be rotatable. From the both end portions of the base bracket 31. supporting plate portions 31a, 31b erect upright and tilt brackets 32, 33 are so fitted on each of the supporting plates potions 31a, 31b as to be rotatable. The tilt brackets 32, 33 are to be connected with the both end portions of the display panel or the like.

[0078] The base 30 and the base bracket 31 are connected through a shaft lock apparatus 40 and the base bracket 31 and each of the tilt brackets 32, 33 are connected through a shaft lock apparatus 50. For these shaft lock apparatus 40, 50, any of the aforementioned embodiments 1 to 8 can be used.

[0079] In this embodiment, the shaft lock apparatus 40 which connect the base 30 with the base bracket 31 are furnished with a shaft 41 fixed on the base 30 and with a friction plate 42 through which the shaft 41 pierces in a condition of bound rotation. Through the base bracket 31 the shaft 41 pierces in a rotatable condition. The shaft in the side of the base bracket 31 pierces through an elastic pressure member 25 which is shown in Figures 14 to 20 in a condition of bound rotation, and, in addition, pierces through a retaining plate 43 in a rotatable condition, and is caulked at the end portion. Therefore, when the base bracket 31 is operated to rotate, the base bracket 31 can be halted at any intended angle within the horizontal level.

[0080] Rotation of the base bracket 31 is to be regulated within a certain range of the angle. Therefore, in the bottom face of the base bracket 31, as is shown in Figures 21 and 24, a stopper protuberance 44 protrudes. The stopper protuberance 44 can be formed by half-blanking against the base bracket 31 by the press.

[0081] Figure 27 shows a friction plate 42 facing this stopper protuberance. In the friction plate 42, a non-circular shaped axial hole 42a, which is engaging with the shaft 41, is formed. The friction plate 42 is a plate shaped like a letter 「～」 and has stopper plates 42b, 43c, which slantingly protrude toward the stopper protuberance 44. The space between the these stopper plates 42b, 42c is a rotatability range of the base bracket 31 and the rotation of the base bracket 31 stops by the stopper protuberance 44 contacting with any of the stopper plates 42b, 42c, caused by the rotation of the base bracket 31. Thereby, the angle of a display panel or the like can be adjusted within the horizontal level.

[0082] In this embodiment, the shaft connecting the base bracket 31 with the tilt brackets 32, 33 is furnished with a tilt shaft 51 fixed on the supporting plate portions 31a, 31b of the base bracket 31, and with a spacer 52,

a friction plate 53, an elastic pressure member 54 and a retaining plate 55 which are fitted on the tilt shaft 51. Each of the tilt bracket 32. 33 is fitted in a condition that the shaft receiving plate portions thereof 32b, 33b are put between the friction plate 53 and the elastic pressure portion 54. It should also be noted that the spring shown in Figures 14 to 20 can be used for the elastic pressure member 54.

[0083] Figure 26 shows the tilt shaft 51 to be composed of a fitting axis portion 51b, having a circular shape, and a connecting axis portion, having a non circular shape, which are formed therein. The fitting axis portion 51b is shaped to be somewhat larger in the diameter thereof than the connecting axis portion 51c. The spacer 52 is fitted on the connecting axis portion 51c in a condition of bound rotation and the friction plate 53 contacts with this spacer 52.

[0084] In such a structure, the spacer 52 is capable of working as is the flange portion 1a of the shaft 1 shown in Figures 8 and 9. Accordingly, as a shaft lock apparatus of this embodiment, the embodiment 5 shown in Figure 8 can be used as it is only by using the tilt shaft 51 instead of the shaft 1. Thereby, cutting the connecting axis portion 51c to be somewhat smaller in the diameter thereof than the fitting axis portion 51b is sufficient, which makes the shape of the tilt shaft 51 simpler to be more easily manufactured.

[0085] In this embodiment, it is possible to adjust the tilt angle of the display panel by rotating the display panel or the like back and forth after connecting the fixing plate portions 32a, 33a of the tilt brackets 32, 33 with the both end portions of the display panel or the like. In this case, because the tilt brackets 32, 33 support the both end portions of the display panel or the like with the right and left ends thereof, the manipulating force is well dispersed to the both sides. Therefore, it is possible to rotate the display panel or the like and to keep the angle thereof.

[0086] The present invention is not restricted within the aforementioned embodiments and capable of being varied. For example, it is possible to assemble a shaft lock apparatus by engagement of a nut, not by caulking the piercing end portion of the shaft 1, which in this case is possible if a male screw is formed in the outer surface of the end portion of the shaft 1. It is also possible to furnish more than two elastic pressure portions, or to furnish a single elastic pressure portions, or to omit the friction plate 9. Furthermore, it is possible to use a compression spring as an elastic pressure portion, in which case the pressurizing force can be applied by using a plate-like spacer to compress the compression spring.

Possibility of Industrial Utilization

[0087] As described above, according to the invention of Claim 1, as an elastic pressure member rotates together with the shaft in one united body, it is possible to stabilize a friction torque and, in addition, to enable a simple structure with a smaller number of the parts so as to be assembled more easily.

[0088] According to the invention of Claim 2, as an elastic pressure member and a friction plate rotate together with the shaft to bring forth a friction torque between the elastic pressure member and the rotated member and between the friction plate and the rotated member, it is possible to stabilize the friction torque while the structure is simpler with a smaller number of the parts and, in addition, the friction plate improves the durability.

[0089] According to the invention of Claim 3, as an elastic pressure member pressurizes the rotated member by fitting a friction plate, a rotated member, an elastic pressure member and a retaining plate on the shaft in such order, it is possible to keep the relative angle between the rotated member and the shaft at any intended angle and to stabilize the friction torque and, in addition, to assemble more easily.

[0090] According to the invention of Claim 4, as the border region between the flat portion and the rising portion linearly contacts with the rotated member to bring forth a friction torque, it is possible to keep the relative angle between the rotated member and the shaft with surety.

[0091] According to the invention of Claim 5, as an elastic pressure member facially contacts with the rotated member to bring forth a friction torque, it is possible to keep the relative angle between the rotated member and the shaft with surety.

[0092] According to the invention of Claim 6, as abrasion of the rotated member can be prevented and so a large intensity is not necessary for an rotated member, it is possible to utilize cheaper materials and to extend utilizable materials.

[0093] According to the invention of Claim 7. it is possible to increase flexure volume in the whole elastic pressure members or to increase the friction torque to enable extensive adjustment of the friction torque, along with the effects of Claims 1 to 6.

[0094] According to the invention of Claim 8, it is possible to increase flexure volume in the whole elastic pressure members and, consequently, to enable extensive adjustment of the friction torque in the whole elastic pressure members.

[0095] According to the invention of Claim 9, the durability improves because of lubrication by the lubricant.

Claims

1. A shaft lock apparatus **characterized in that** it is furnished with a rotated member through which the aforementioned shaft pierces in a condition of bound rotation, and with an elastic pressure member which keeps the relative angle between the rotated member and the shaft at any intended angle by pressurizing the rotated member.

2. A shaft lock apparatus **characterized in that** it is furnished with a rotated member through which the aforementioned shaft pierces in a condition of bound rotation, and with an elastic pressure member which keeps the relative angle between the rotated member and the shaft at any intended angle by pressurizing the rotated member, and with a friction plate through which the aforementioned shaft pierces in a condition of bound rotation to be superposed on the aforementioned rotated member.

3. A shaft lock apparatus **characterized in that** a friction plate through which the shaft pierces in a condition of bound rotation, a rotated member through which the shaft pierces in a condition of free rotation, an elastic pressure member through which the shaft pierces in a condition of bound rotation, and a retaining plate through which the shaft pierces in a condition of bound rotation are fitted on the shaft **in that** order to be superposed, and that by caulking the piercing end of the shaft piercing through the aforementioned retaining plate the elastic pressure member pressurizes the rotated member to keep the relative angle between the rotated member and the shaft at any intended angle.

4. A shaft lock apparatus, stated in any of the Claims 1 to 3, which is **characterized in that** the aforementioned elastic pressure portion is shaped to have a flat portion and rising portions which erect from the both sides of the flat portion.

5. A shaft lock apparatus, stated in any of the Claims 1 to 3, which is **characterized in that** the aforementioned elastic pressure portion is shaped to be curved like a letter C.

6. A shaft lock apparatus, stated in any of the Claims 2, 4, or 5, which is **characterized in that** at least a friction plate which is placed between the aforementioned rotated member and the elastic pressure portion is in one united body with the rotated member.

7. A shaft lock apparatus, stated in any of the Claims 1 to 6, which is **characterized in that** at least two elastic pressure members, which are mentioned above, are placed along the aforementioned shaft.

8. A shaft lock apparatus, stated in any of the Claims 1 to 7, which is **characterized in that** at least two elastic pressure member, which are mentioned above, are placed to sandwich the aforementioned rotated member from the both sides.

9. A shaft lock apparatus, stated in any of the Claims 4 or 5, which is **characterized in that** lubricant retaining portions which retain a lubricant are formed in the aforementioned elastic pressure member.

Fig. 1

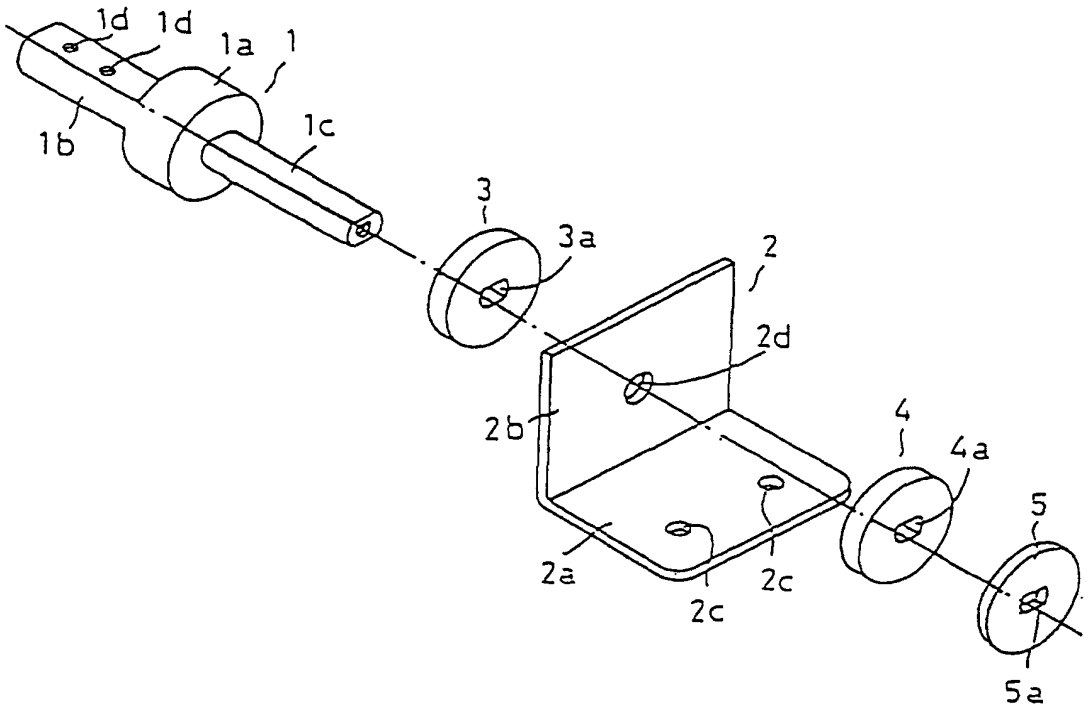

Fig. 2

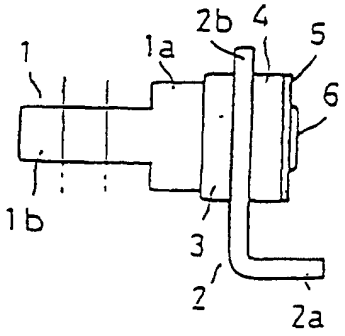

Fig. 3

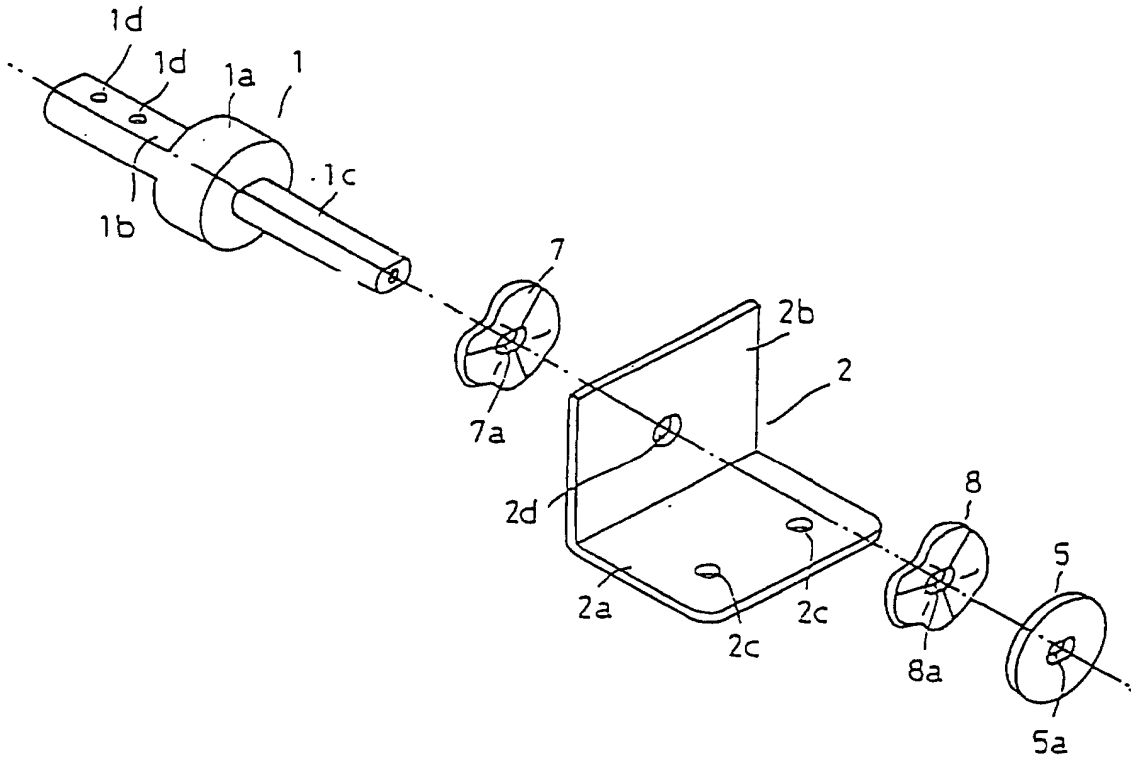

Fig. 4

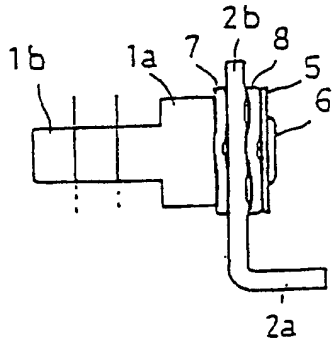

Fig. 5

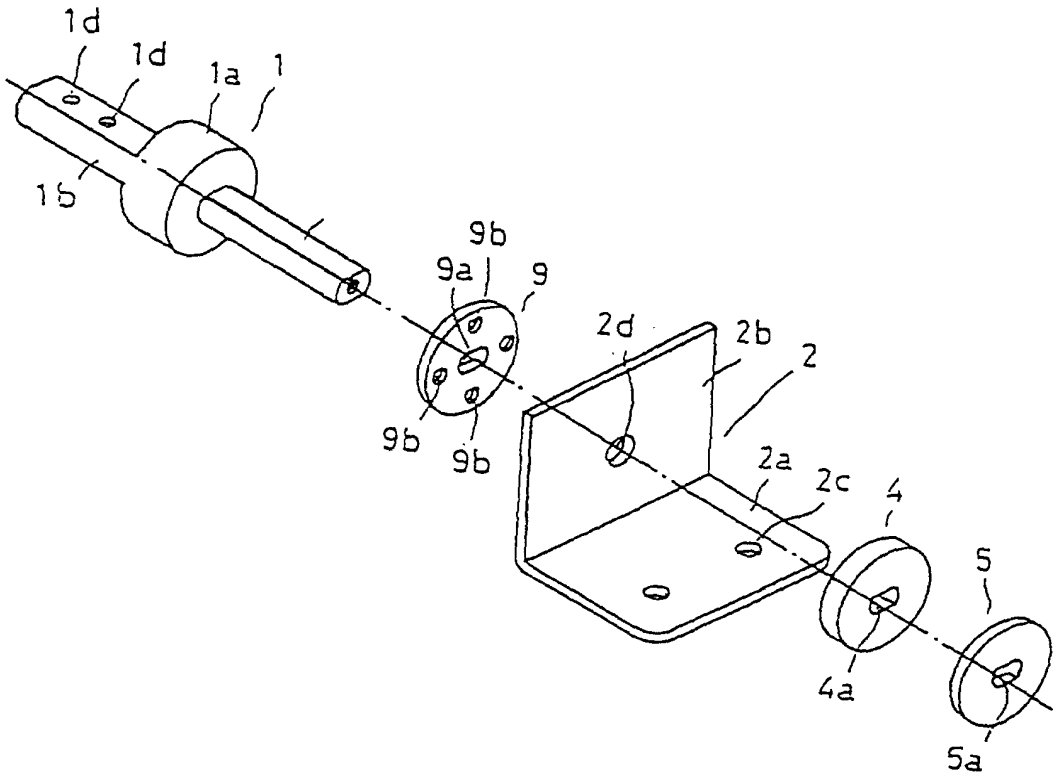

Fig. 6

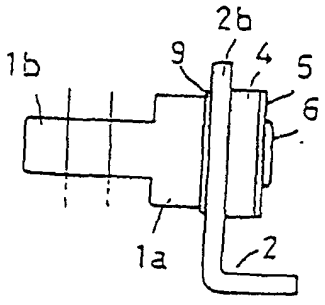

Fig. 7

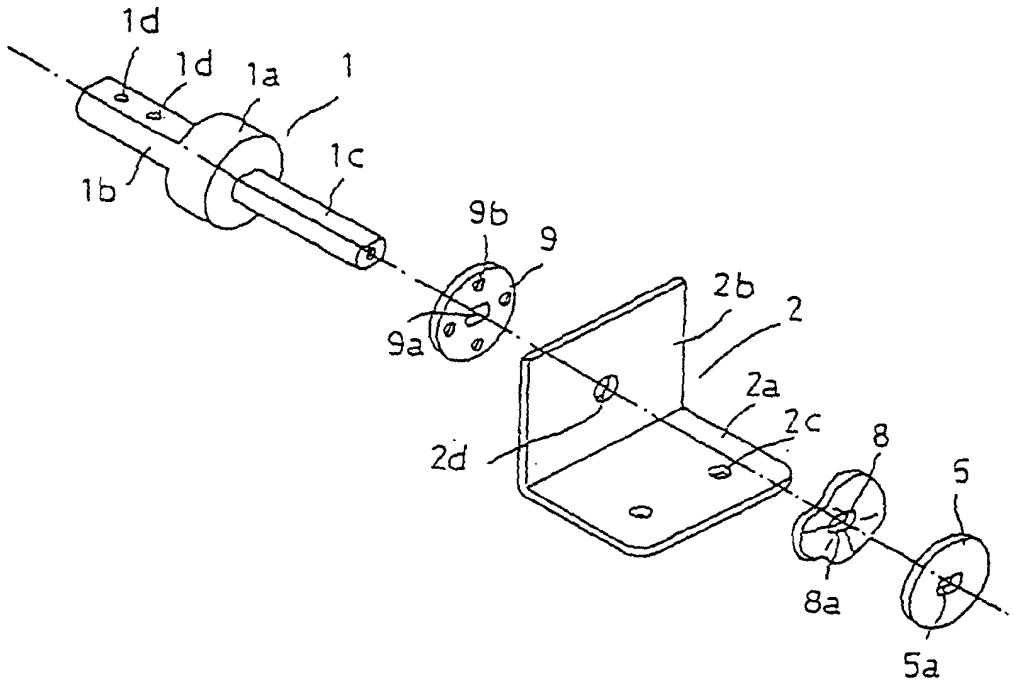

Fig. 8

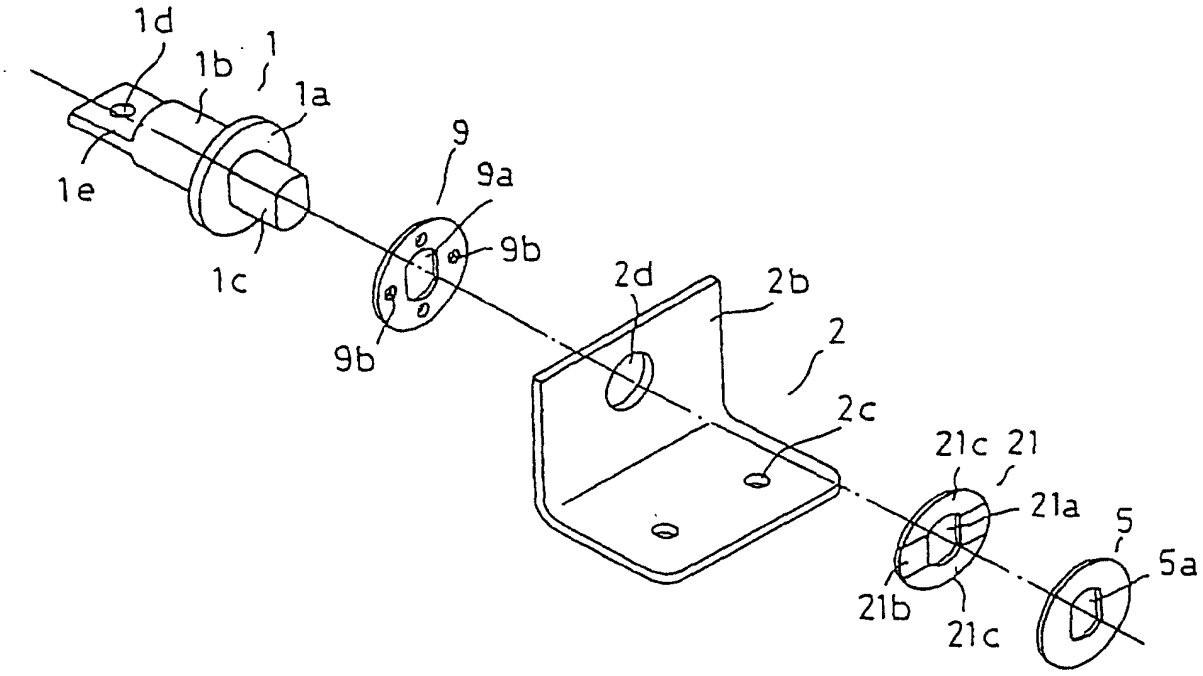

Fig. 9

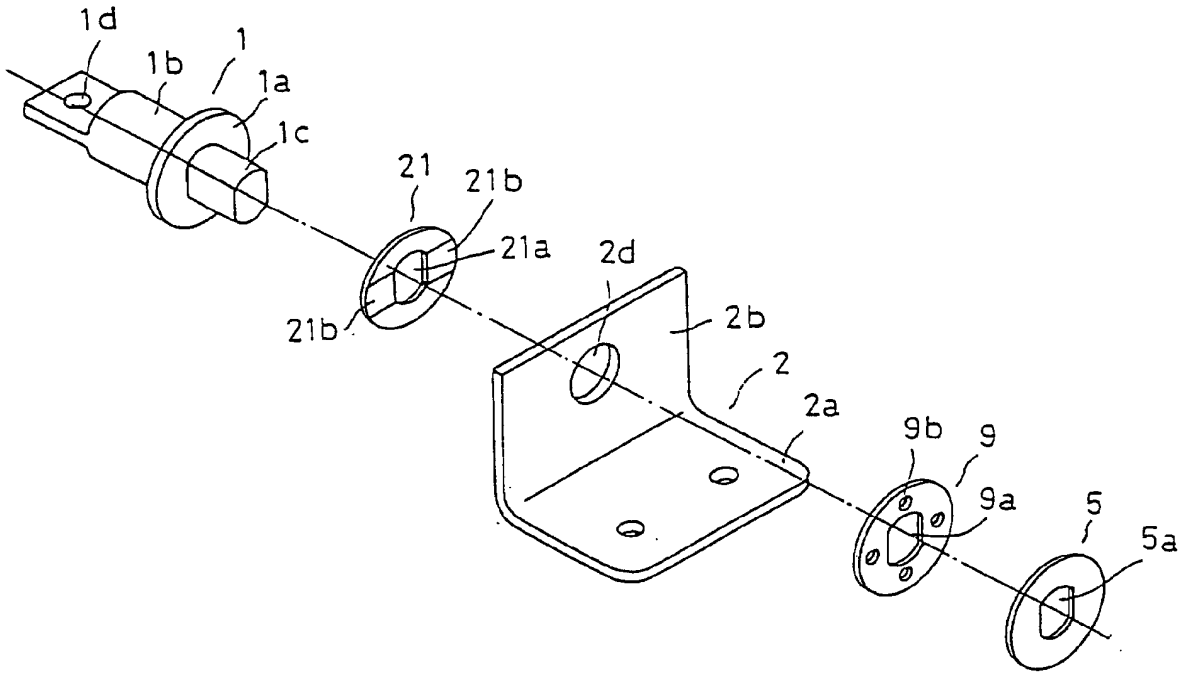

Fig. 10

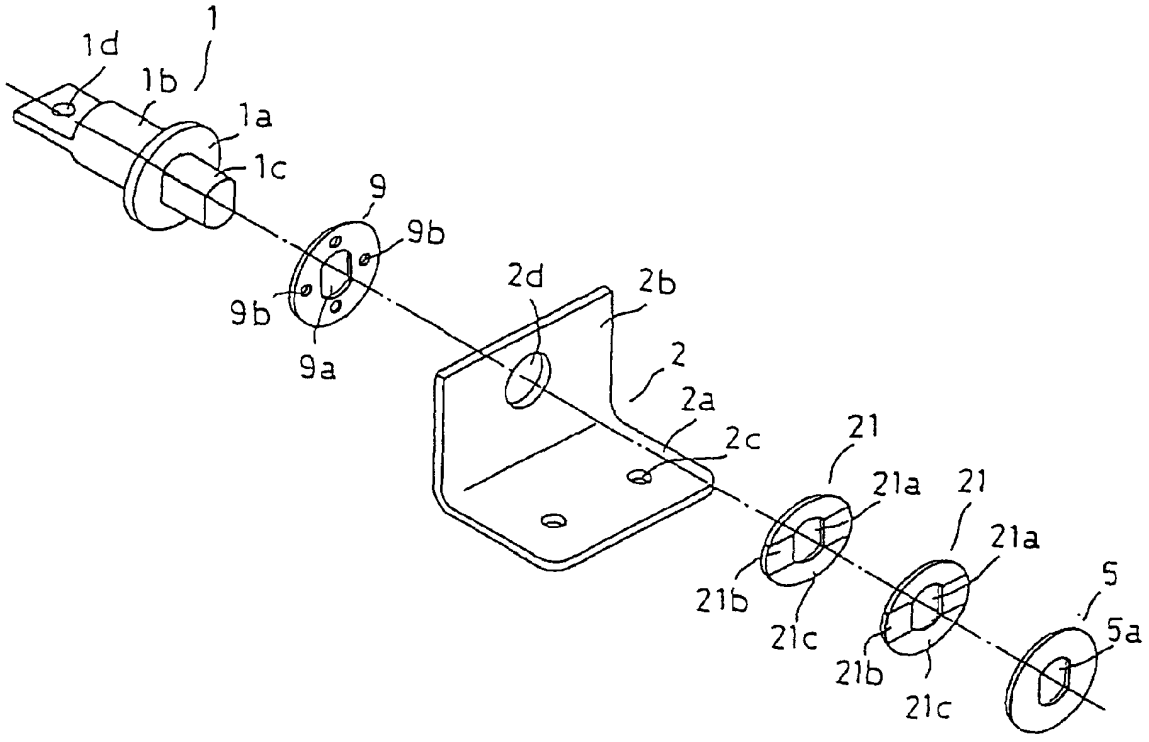
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Fig. 11

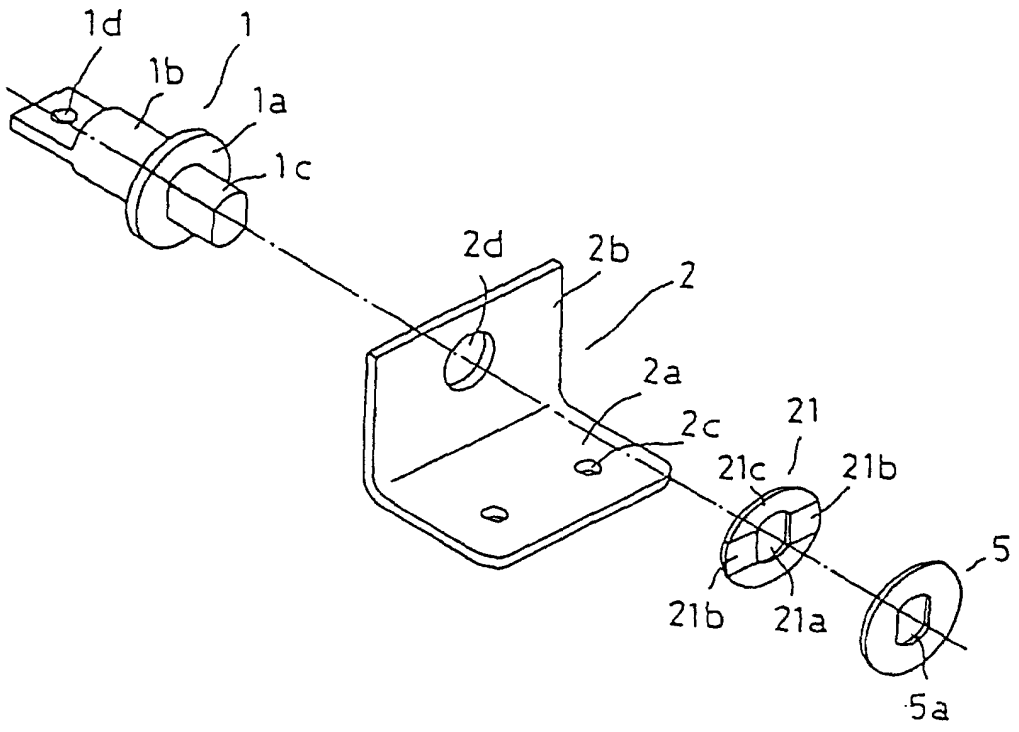

Fig. 12

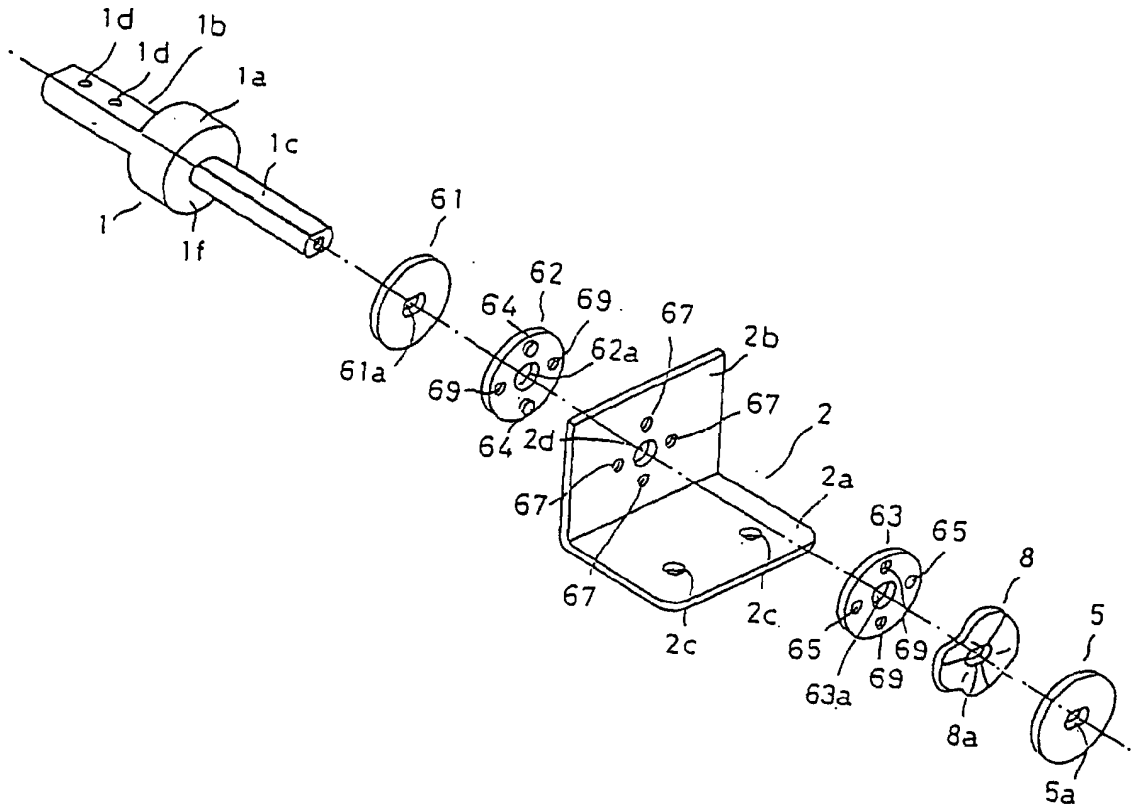
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Fig. 13

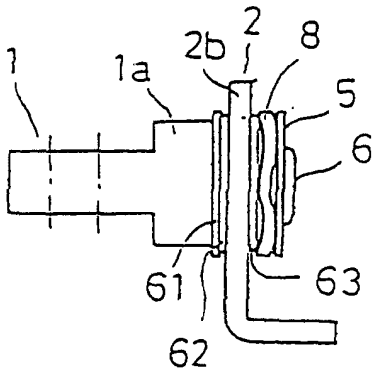


Fig. 14

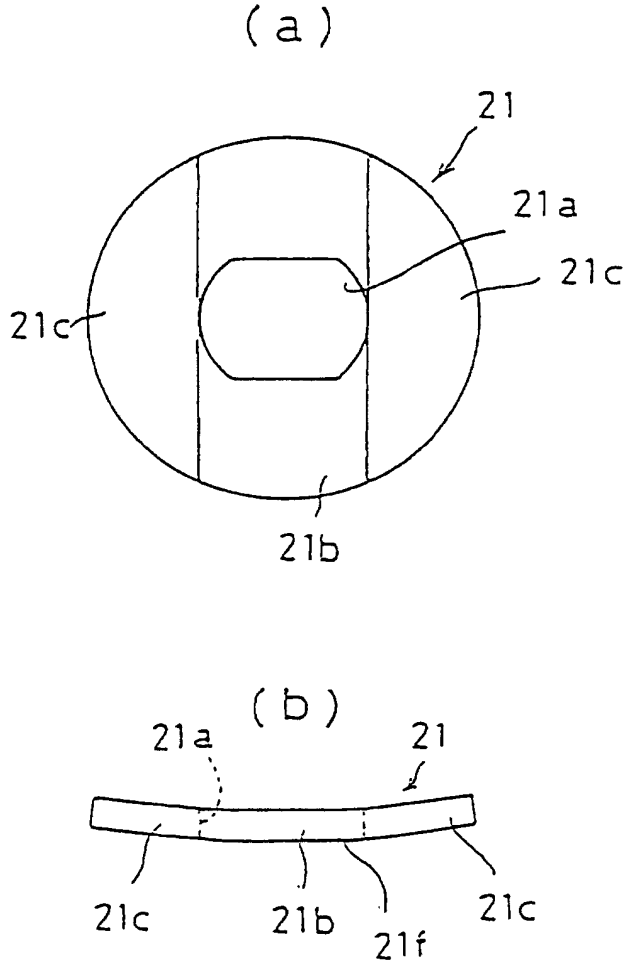


Fig. 15

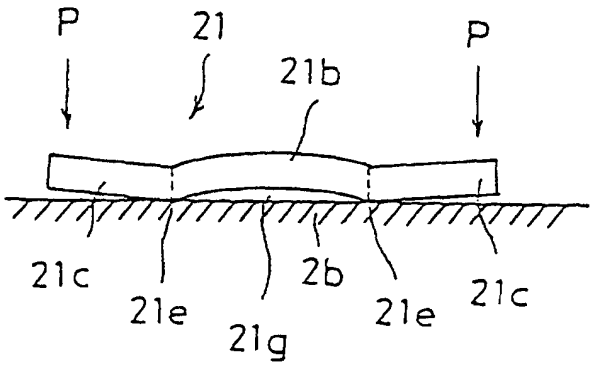


Fig. 16

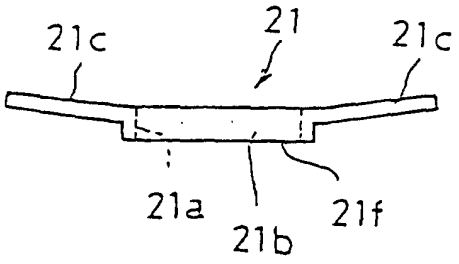
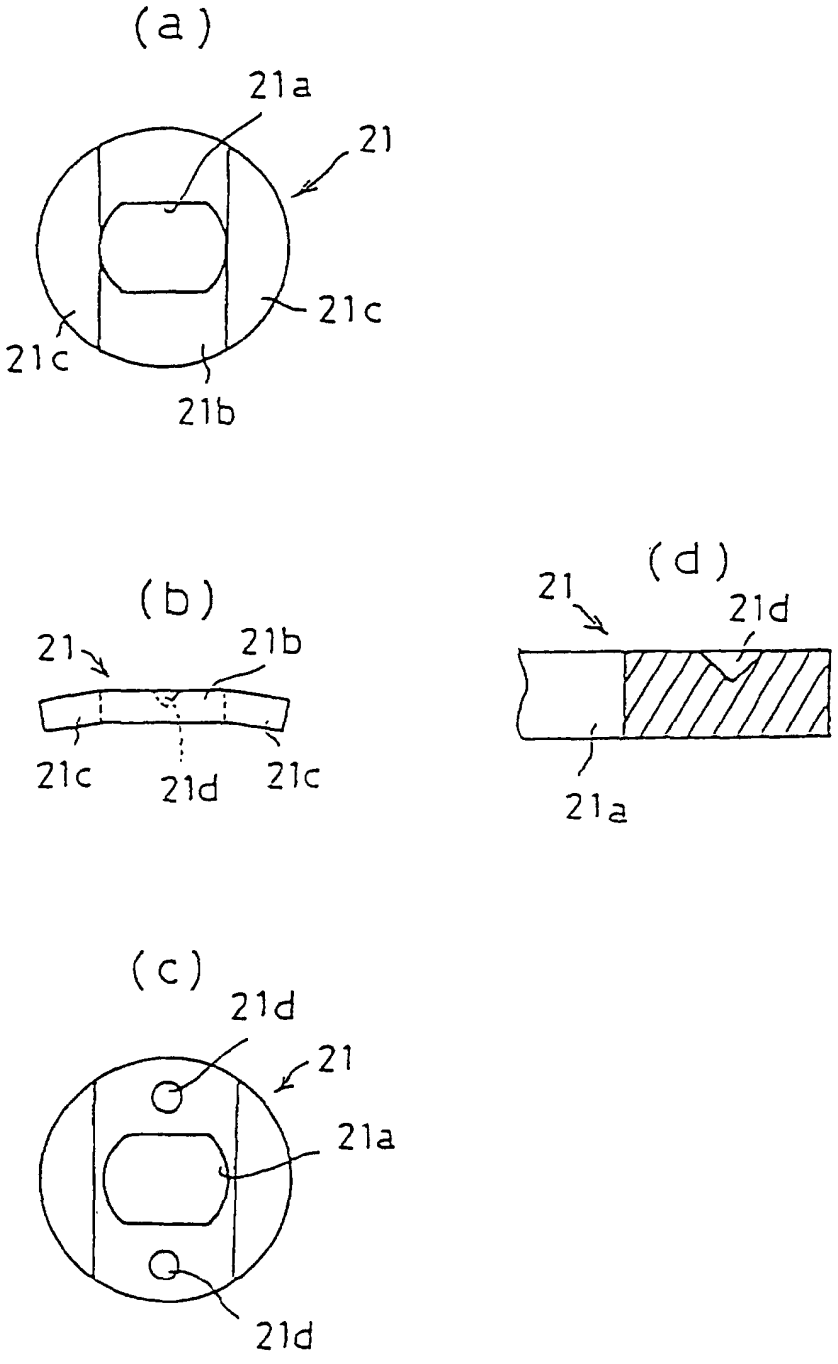


Fig. 17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(b)
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Fig. 18

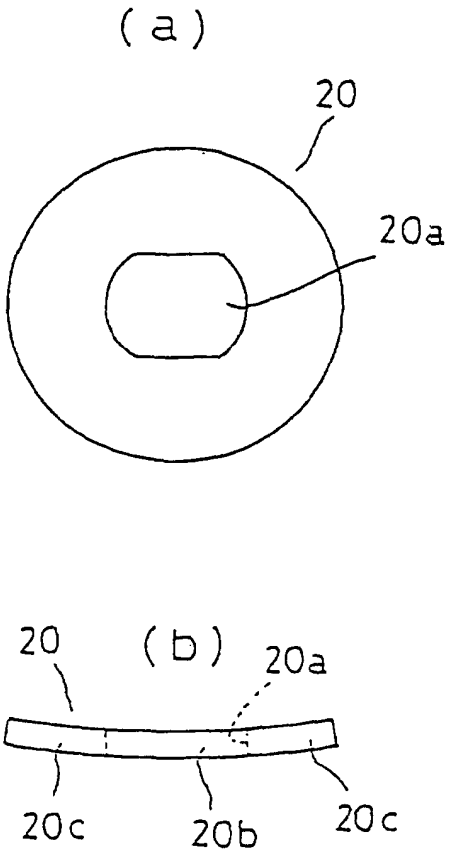


Fig. 19

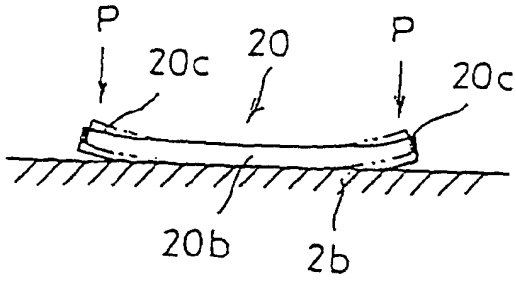


Fig. 20

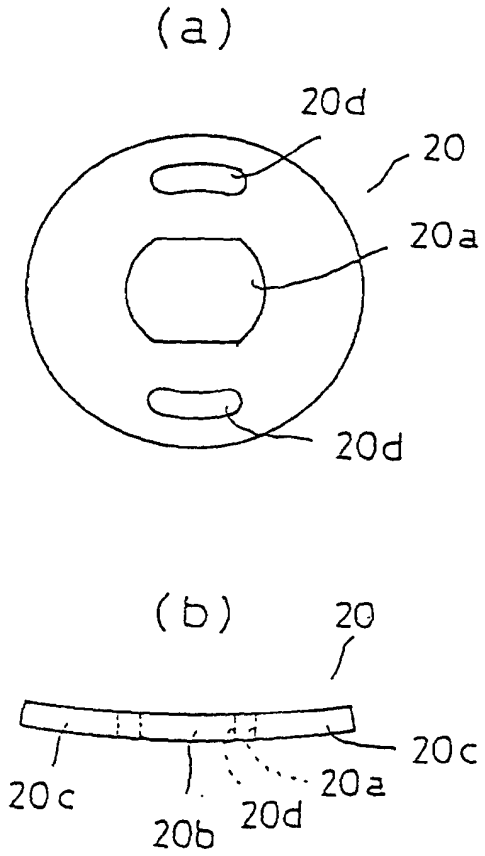


Fig. 21

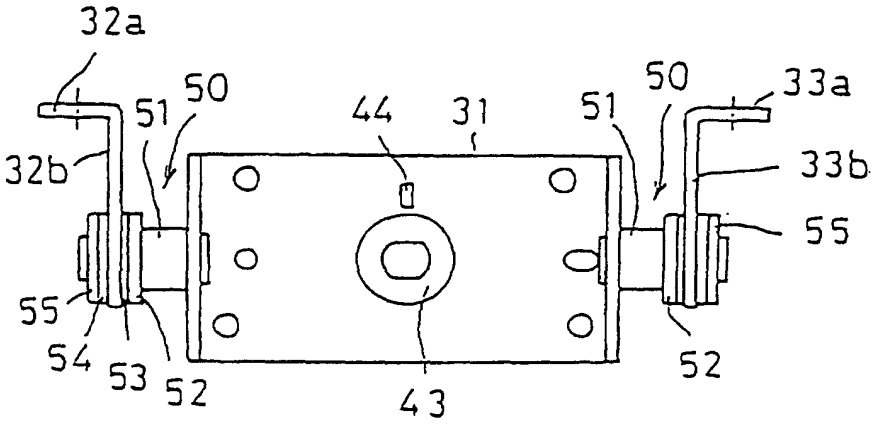


Fig. 22

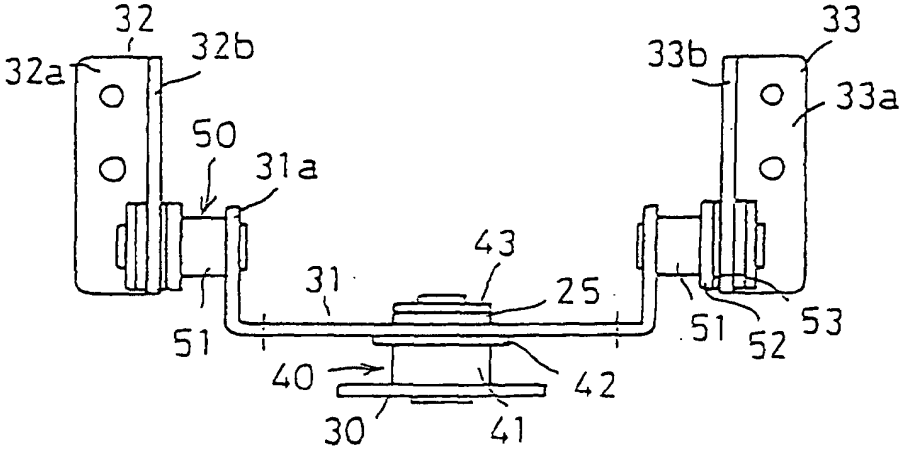


Fig. 23

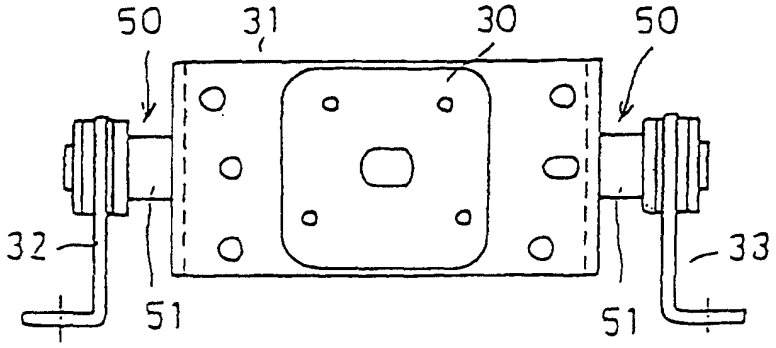


Fig. 24

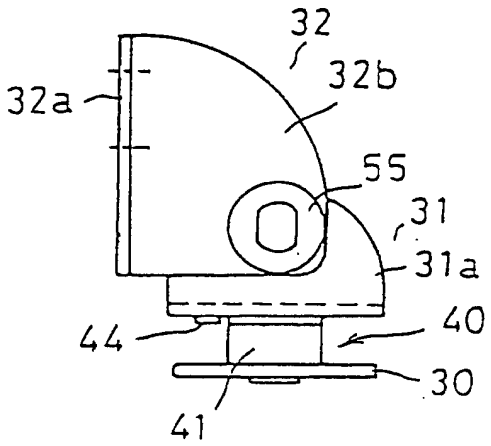


Fig. 25

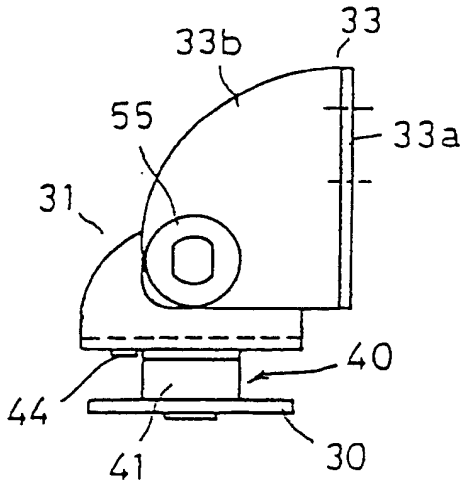


Fig. 26

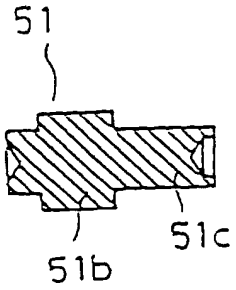


Fig. 27

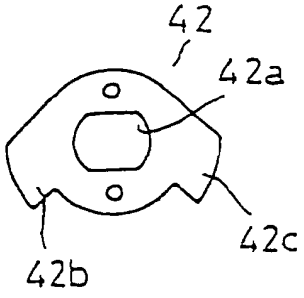
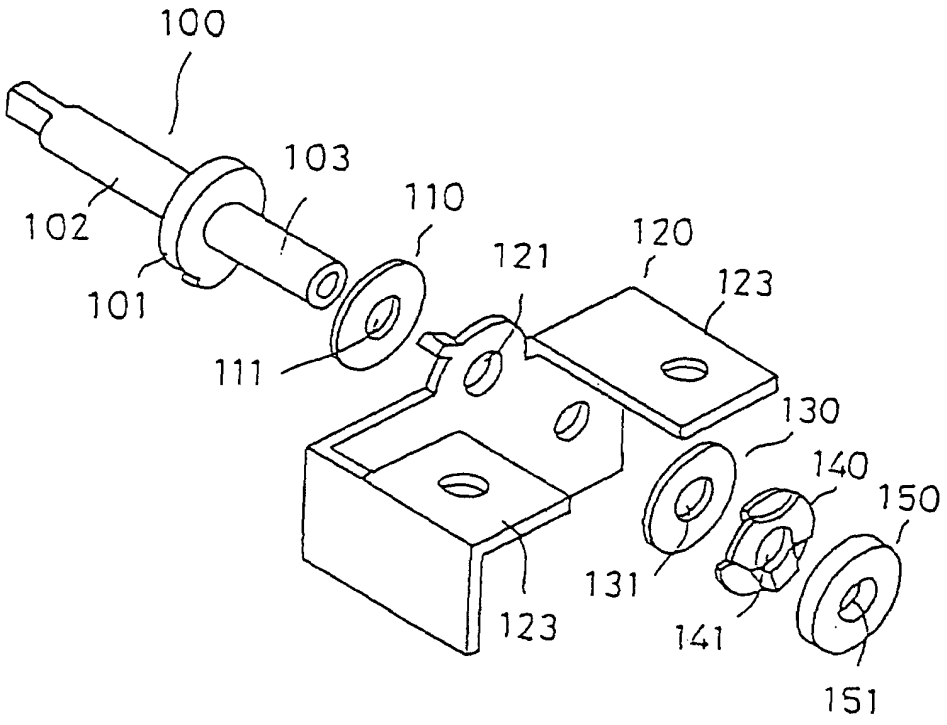


Fig. 28



Explanation of Numbers in the Drawings

1. Shaft
2. Bracket
3, 4 Elastic pressure members
7, 8 wave springs
9. Friction plate
20. C-shaped spring
21. U-shaped spring

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP00/03903

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[7] F16C11/10, E05D11/08

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int.Cl[7] F16C11/04 - 11/10, E05D11/00 - 11/10

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1926-1996 Toroku Jitsuyo Shinan Koho 1994-2000
Kokai Jitsuyo Shinan Koho 1971-2000 Jitsuyo Shinan Toroku Koho 1996-2000

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	JP, 3011568, U (Kato Denki K.K.), 22 March, 1995 (22.03.95), page 6, Par. No. [0012] (Family: none)	1-4,7-8 5-6,9
Y	JP, 10-26126, A (Kato Denki K.K.), 27 January, 1998 (27.01.98), page 3, lines 20 to 34 (Family: none)	5,9
A	US, 5022778, A (Sheng N. Lu), 11 July, 1991 (11.07.91), Fig. 2 & GB, 2249583, A	1-3

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
07 September, 2000 (07.09.00)	19 September, 2000 (19.09.00)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

Form PCT/ISA/210 (second sheet) (July 1992)